D. O'BRIEN JR. P.E.
T. A. KWASNY P.E.
M. LIEBIG V.P.
J. PILIPISZYN V.P.

O'BRIEN & ASSOCIATES, INC.

CONSULTING ENGINEERS

SOIL STUDIES
INSPECTION
TESTING
ENGINEERING

P.O. BOX 1231 - ARLINGTON HEIGHTS, ILLINOIS 60006 - (312) 398-1441

August 9, 1982

EPA Region 5 Records Ctr.
334697

Mr. Carl Kupfer
Spaceco Inc.
4849 Golf Road
Skokie, Illinois 60077

Job No. 23282

Re: Review of subsurface information proposed Greene Valley Landfill II, DuPage County, Illinois

Dear Mr. Kupfer:

In accordance with your request, we have reviewed available subsurface information presented for the proposed Greene Valley Landfill II to be located at Greene Road immediately north of the DuPage County and Will County line. In addition, we have examined general subsurface conditions in the area relative to the use of the proposed property as a landfill site.

The proposed Greene Valley Landfill II site is proposed southeast of the existing Greene Valley Landfill located in DuPage County in the south half of Section 34, Township 38 North, Range 10 E. The proposed expansion is in an area of approximately 35 acres located southeast of the existing landfill site.

The original report for the proposed landfill site was submitted by Emcon Associates in a report dated March 6, 1974. In this report, information obtained from 28 soil borings performed by Testing Service Corp. was reviewed. Boring logs were submitted in a report prepared by Testing Service Corp. dated March, 1971. Additional subsurface information describing specific soil conditions within the area of the proposed expansion were submitted by Patrick Engineering Inc. in their report of April 22, 1982. In all, a total of 94 soil borings were performed throughout the entire landfill area site with 10 of these borings location on or adjacent to the proposed 35 acre expansion area.

Regarding soil conditions, glacial deposits overlying a dolomitic

limestone bedrock deposit at depths of 40' to 60' below ground surface comprise the generalized soil profile. In the Emcon report, these generalized soil conditions were described as "The composition of the glacial deposit was found to be predominantly silty clay with subordinate sand and gravel. From the ground surface to a depth varying from 7' to nearly 50', the entire site was found to be underlain by silty clay. Generally lying between this upper clay zone and bedrock are sand and gravel layers which are linticular with limited lateral extent and generally interbedded with the silty clay."

The sand and gravel deposits described in both the Emcon and Patrick reports represent permeable materials which would permit the migration of leachates and gases created in the landfill site off the property and, with the proximity of the east branch of the DuPage River to the proposed landfill site, to a major water course. Although it is indicated that the sand and gravel layers have limited lateral extent, boring 22 performed in the southwest corner of the proposed expansion area reveals sand and gravel materials from a depth of 16' below ground surface to the maximum depth of this boring, 40.0'. Also, although the Emcon report indicates that the sand and gravel deposits show a general absence of continuity, a review of their sections, particularly section CC, shows continuity of the sand and gravel deposit over the entire site.

In each of the reports indicated above and in the design drawings prepared by Waste Management of Illinois, Title Sheet dated April 25, 1982, and the permit application, procedures are described to modify these very permeable materials by installing a compacted clay layer having a maximum permeability of 1×10^{-7} cm/sec. In the permit application, design drawings and the Patrick Engineering report, the thickness of this compacted clay blanket is indicated at a minimum of 10'. In the Emcon report, the thickness is indicated as a minimum of 5' and in the Testing Service report, the thickness is indicated at a minimum of 2'. Although a compacted clay liner theoretically can provide an impermeable layer to minimize the migration of leachates and gases, problems have been encountered in predicting the permeability of these clay liners. In fact, a number of investigators have found that the permeability of compacted clays will decrease by one hundred fold with no change in density and moisture content, simply by changing the compactive effort (Mitchell, et al, 1965). In addition, with extensive granular materials such as were encountered in the area of the proposed landfill expansion, the excavation of these materials and

their replacement with a compacted clay material may be very difficult. An extensive dewatering system may be necessary and, since some of the soils are located below the elevation of the hydrostatic water table, quick or semi quick conditions could develop with these materials following the release in confining overburden pressure and under construction activity. Compaction of clays placed on these materials may not be possible due to this quick or semi quick condition. Because of these items, it would appear that the modifications indicated in all of the reports and shown on the design drawings and permit application may not necessarily provide the sufficiently permeable layer necessary to prevent migration of leachates and gases to adjacent properties.

Our analysis of the design for the proposed landfill expansion indicates that bottom elevations have been established approximately as determined by Patrick Engineering Corp. from the 10 soil borings performed on the property. However, it is indicated by Patrick Engineering that additional exploration and testing should be performed and it would appear appropriate that, because of the extent of sand and gravel materials encountered, the additional soil borings should be performed prior to finalization of the design for the proposed landfill expansion. Also in the performance of any additional borings, continuous samples should be obtained to accurately establish the location and extent of the deposits of granular materials. In the borings performed to date, samples have been taken at 5' intervals with an average recovery of approximately 1' or less. This provides subsurface information on only approximately 20% of the soil profile and, where a thorough analysis of the location and extent of granular materials is required, data on 100% of the soil profile should be obtained at the boring locations. Also, in the performance of these borings, which will penetrate any clay material to the bedrock deposits providing well water to adjacent properties, grouting of the borings should be performed after their completion to assure that no migration of leachates and gases occurs through the open borings to the water well aqufer.

In addition to the performance of the 94 borings, monitoring wells have been installed and, available information indicates that such a well is located in the vicinity of boring 22. Although these wells were installed for the purpose of monitoring ground water levels, ground water samples should be obtained and chemically analyzed to determine the extent of any infiltration of contaminants from the existing landfill site. It may be desirable to install additional monitoring wells off the property, depending upon the extent of contaminants found in those monitoring wells installed in the areaof the proposed landfill expansion.

This report has been based upon a preliminary review of the data submitted with the permit application for the Greene Valley Landfill II site. Additional subsurface information and laboratory testing appears desirable and, if you wish, we would welcome the opportunity to review all additional information that is obtained to analyze and evaluate the effect of this data on the procedures involved in the installation of the proposed landfill expansion.

If there are any questions with regard to information submitted in this report, please do not hesitate to contact us.

Very truly yours,

O'BRIEN & ASSOCIATES, INC.

Dixon O'Brien, Jr.
Registered Professional Engineer, IL.

DOB/j

EVALUATION OF PROPOSED 35 ACRE ADDITION TO GREENE VALLEY SANITARY LANDFILL DU PAGE COUNTY, ILLINOIS

C. KUPFER, P.E., PRINCIPAL - SPACECO
&
D. O'BRIEN, JR., P.E., PRINCIPAL - O'BRIEN & ASSOCIATES, INC.

INTRODUCTION

The intent of this study is to evaluate the impact on the health, safety and welfare of the community as a result of continued development of the captioned sanitary landfill. The initial site contains approximately 200 acres, and the proposed expansion area includes an additional 35 acres. The Illinois Environmental Protection Agency issued an operating permit (1974-30-OP) for the original landfill on October 10, 1974, and eight supplemental permits through 1981. The applicant, Waste Management of Illinois Inc., has petitioned the DuPage County Board of Commissioners, pursuant to the Senate Bill 172 siting criteria, to consider the approval of an adjacent tract for the disposal of refuse in accordance with plans, specifications and other documents presented at a public hearing held on August 11, 1982.

DISCUSSION

The data used in this evaluation was obtained from:

1. The aforementioned plans, specifications and other documents submitted by the applicant at the public hearing;
2. Testimony presented by the applicant;
3. Supplemental information provided us by Waste Management.

Concern about the efficacy of the landfill operation focuses on the following issues:

1. Insufficient sub-surface data in critical sections of the expansion area;
2. Production and disposition of leachate;
3. Inadequate and improper drainage designs;
4. Lack of adequate provision for sediment control;
5. Severe shortage of clay cover materials.

While only a 35 acre expansion area is under consideration in the present proceedings, the entire landfill operation needs to be examined. The expansion area and the original landfill are environmentally interrelated

and cannot be dealt with individually. The expansion area is an integral part of the whole; its geological setting, final landform, leachate collection system and surface drainage watercourses are interdependent.

1. INSUFFICIENT SUBSURFACE DATA

The sand and gravel deposits described in both the EMCON (geotechnical consultants for the original landfill) and Patrick (consultants for the expansion) reports represent permeable materials which would permit the limits of the combined landfill area. Despite the fact that the report indicates that the sand and gravel layers have limited lateral extent, boring 22 performed in the southwest corner of the proposed expansion area reveals sand and gravel materials from a depth of 16' below ground surface to the maximum boring depth of 40'. Also, although the EMCON report indicates that the sand and gravel deposits show a general absence of continuity, a review of their sections, particularly "CC", shows continuity of the sand and gravel deposit over the entire site. The proximity of permeable materials to the proposed landfill base dictates the need for considerably more soils information, especially along the south property line. The recent exposure of a gravel dome in Area #2 of the original landfill points up the need for securing adequate subsoil information before landfill design commences.

It was noted that nowhere in the documentation was there a recommendation, direction or requirement that bore holes be grouted after completion of sampling. Without that procedure, a significant potential for groundwater interflow is created. Shallow groundwater may then freely seep downward into the shallow dolomite aquifer.

Additional concerns are expressed in the report prepared by O'Brien & Associates, Inc., attached as Exhibit 1.

2. PRODUCTION AND DISPOSITION OF LEACHATE

The supplemental information to the permit application for the landfill expansion indicates on page 10 that "the portion of precipitation that will run off will be near 60%. The remainder (40%) of the precipitation will be stored in the soil and evaportranspirated by the air and the vegetative cover". The statement concludes that "no infiltration will occur and no leachate will be produced upon application of the final cover material on the landfill".

A water balance computation for the combined sites will demonstrate that the foregoing is not accurate.

Percolation through final cover:

Average Annual Precip. (O'Hare Field, Nat'l. Weather Service)	34.0"
Average Annual Potential Evapotranspiration (Thornwaite, AmGeographical Inst.)	26.0"
Excess (Average Annual)	8.0"

Inflow through cover:

60% will run off (per permit application)
hence 40% will infiltrate.

$\therefore$ 8.0" x 40% = 3.2" Average Annual Inflow =

$$\left(\frac{3.2}{12}\right) \text{ ft.} \times 235 \text{ ac.} \times 43{,}560 \frac{\text{ft.}^2}{\text{ac.}} = \underline{2{,}729{,}760 \text{ ft.}^3}$$

The refuse fill has absorptive capacity considerably greater than the final cover material and, hence, the cover will not tend to be waterbound. All the water which percolates through the cover will in turn seep into and through the refuse cells. Once field capacity is reached, flow through the landfill tends toward steady-state flow. That is, there will be no further storage in the refuse, and seepage will occur into the base of the landfill. This clay interface has an absorptive capacity which can be calculated as follows:

Darcy's law states that $Q = KiA$ where:

Q = Seepage Rate
K = Soil Permeability
i = Hydraulic Gradient
A = Base Area of Landfill

$K = 1.0 \times 10^{-7}$ cm/sec $= 3.28 \times 10^{-9}$ ft./sec.
$A = 235$ ac $= 235 \times 43{,}560 = 1.024 \times 10^{7}$ ft.^{2}
$i = 1.0$ (vertical gradient)
$Q = (3.28 \times 10^{-9}$ ft./sec.$)(1.024 \times 10^{7}$ ft.$^2)(1.0)$
$= 3.359 \times 10^{-2}$ ft.^{3}/sec.

Total annual seepage potential through interface:

$Q = 3.359 \times 10^{-2}$ ft.^{3}/sec. x (3600 x 24 x 365 sec/yr)
$= 1.059 \times 10^{6}$ ft.^{3}/yr = $\underline{1{,}059{,}000 \text{ ft.}^3/\text{yr}}$

When comparing this interface seepage potential with the total annual percolation through the final cover, the following excess inflow is generated:

Total annual inflow	=	2,729,760 ft.^{3}
Less interface seepage	=	1,059,000
Excess Inflow:	=	1,670,760 ft.^{3}

drain leachate seepage to the base of the landfill. If all the excess rainfall inflow seeped through the refuse and were collected by underdrains, that ultimate daily leachate load is calculated as follows:

$$1{,}670{,}760 \text{ ft.}^3 \times 7.48 \text{ gal/ft.}^3 \div 365 \text{ days} =$$

$$34{,}239 \text{ gal/day}$$

This daily volume would need to be pumped into 5,000 gallon tank trucks (no other treatment method is contemplated in the submission) and hauled to a wastewater treatment plant. This flow rate represents, on average, several daily round trips by tanker on a perpetual basis. The leachate, a highly polluted wastewater, will continue to be generated until all refuse is decomposed. The process of decomposition can be prolonged for decades.

It is the applicant's goal to exclude infiltration from the landfill, arrest leachate formation, and thereby greatly reduce the rate of decomposition. While that objective is attainable in climates where evaportransportation exceeds precipitation, it is not attainable in northern Illinois. To the contrary, the foregoing water balance calculations have shown net infiltration of a substantial volume of water. Not included in that estimate is water entering through cracks inevitably created by landfill settlement. Emcon advises in its report of the likelihood of surface crack formation as a result of such settlement. The calculations also do not include the continuous accumulation of infiltration entering the landfill during actual operations. Working faces of open cells are exposed and water accumulations are co-disposed into the refuse. Furthermore, significant amounts of water are introduced by way of municipal sewage sludge and domestic septage co-disposal.

Inflow of water into the landfill as described above increases saturation levels and accelerates the production of leachate. The applicant's engineers have reported only insignificant volumes of leachate generation. This observation is not at all surprising since absorption of moisture by refuse may continue for a considerable period of time. Once saturated, however, continuous seepage may be expected as shown by previous computations.

The ability of the widely-spaced underdrain system to withdraw the excess needs to be examined. Furthermore, any blinding, blockage or pipe malfunction of interior drain pipe may render a major section of the system inoperable. Such an occurrence has the effect to significantly increase the hydraulic head in the fill. A possible result is a breakthrough along the sideslopes whose cover is only four feet (by design), compared with 10 foot interface and sideliner thickness. A breakthrough will result in surface water pollution since no provisions are included in the plans to contain or to treat such discharges.

Significant hydraulic heads can be generated within the projected refuse depths up to 200 feet. Failure of the clay base, through fracture or as a result of lower permeabilities than predicted, has the potential of discharging leachate plumes into the more permeable sand and gravel lenses occurring below portions of the landfill base. Such failures are difficult to locate and even more difficult to repair should they occur anywhere else but along the perimeter of the landfill.

There are no interior manholes or risers to observe water levels or to withdraw leachate if it were to become necessary.

3. INADEQUATE AND IMPROPER DRAINAGE DESIGNS

A study of the documents presented at the hearing indicates that major changes to the drainage patterns have occurred and will continue to occur as a result of the landfill development.

a) Offsite dominant drainage flows have been diverted into the DuPage River;

b) The amount of runoff from the completed landform will be significantly greater than the land in its natural topographical condition. The applicant indicates in the application materials that "the portion of precipitation which will runoff will be near 60%." He contemplates minimizing the infiltration into the refuse and, inturn, intends to shed as much rainfall as possible. The natural terrain sheds approximately 30 to 40 percent of the rainfall by comparison. The runoff fraction is, therefore, being almost doubled for the landfill area.

c) The landfill, when completed, will significantly accelerate runoff without provision for the temporary storage of those excess flows;

d) The 35 acre expansion area under present topographical conditions is a repository of excess storm flows. Its development into the proposed landform drastically and detrimentally alters its present drainage function.

4. LACK OF ADEQUATE PROVISION FOR SEDIMENT CONTROL

While the construction drawings make reference to a sedimentation control area downstream of one of the two outfalls along relocated Greene Road, no details are provided. In fact, the drawing places the sedimentation control in the DuPage River basin. This is hardly appropriate. The northerly outfall has no provision for such control.

The perimeter drainage ditches indicate sharp changes in flow line gradients. At the predicted high flow rates, considerable erosion may occur in the steeper reaches, while depositing silt in the flat downstream reaches. The bottom slopes designed at

position and weed growth. The reduced carrying capacities will ultimately create backwater conditions upstream if channels are not continuously maintained.

5. SEVERE SHORTAGE OF CLAY COVER MATERIAL

Calculations presented by the applicant in its Annual Engineer's Report to the Forest Preserve District for the 12 month period ending April, 1981 indicate a shortage of clay cover material for the original landfill of almost 3,000,000 cubic yards. We estimate an additional shortage of approximately 430,000 cubic yards of clay or other suitable daily cover material for the 35 acre expansion area. The clay available above the design landfill base elevation is approximately five feet in thickness and will be required to generate final cover material compacted to the approximate four foot thickness. An additional allowance should be made for clay liner material where the seal needs to be increased to 10 feet. No estimate is available for this additional clay volume. The plans call for approximately 16 acres to be sealed. This operation may involve up to 300,000 cubic yards of earthwork, with most of the clay being in-situ material. Undoubtedly the compaction effort will create a net requirement for imported fill. We estimate approximately 20%, or 60,000 cubic yards, for this operation.

Original Landfill	3,000,000 cy
Expansion	430,000 cy
Clay Seal Shortfall	60,000 cy
TOTAL SITE SHORTAGE:	3,490,000 cy

If the shortest offsite haul distance were considered, and a cartage cost of $2.00 per cubic yard (in place) were imputed, the total additional cost to complete the combined landfill would be (in 1982 dollars):

3,490,000 cy @ $2.00 = $6,980,000

This cost presupposes that the material has been obtained at no cost, and that no additional outlays have been made for additional land acquisition.

CONCLUSIONS

A number of deficiencies have been observed in connection with the Greene Valley Landfill and, if left unabated or unresolved, can adversely affect the health, safety and welfare of the community in the vicinity of the landfill site.

1. The known presence of permeable sand and gravel below the landfill base should dictate that additional subsurface investigation is in order in the expansion area. It should be known in advance of construction whether and how much additional suitable clay will be required to effect a bottom and side seal. A severe shortage of in-situ clay already exists and additional shortages would exacerbate that problem.

2. Once saturated, the landfill will generate approximately 2.7 million $ft.^3$ of leachate annually. The clay base is capable of renovating about 1.0 million $ft.^3$. The remaining 1.7 million $ft.^3$ may be withdrawn by the leachate collection system, provided these excess flows seep into the underdrains. A flow net analysis is required to establish whether such seepage would in fact occur. Improper design or failure of the collection system can result in high hydrostatic head in the refuse, and consequent breakthrough in the landfill base or along the external landfill slopes. The resulting leachate discharges have the potential to contaminate the ground and surface waters down-gradient of the landfill. If leachate needs to be withdrawn, it is estimated that approximately seven 5,000 gallon tank truck loads could be expected to be removed on a daily basis once the landfill is complete and the refuse is saturated. Complete treatment is inevitable since the leachate is typically highly polluted.

3. Drainage patterns which existed prior to the development of the landfill have been altered drastically. The resulting conditions include diversions of surface waters, increases in the rates of storm flows generated within the landfill areas, and acceleration of flows without means for the containment of the excess flows.

4. No specific sediment control devices are provided in the applicant's documents. Deposition of eroded soils may occur in on and off site drainageways, and may eventually discharge into the DuPage River. If these deposits are polluted, such pollution has the potential to be transmitted into the receiving waters.

5. An acute shortage of clay cover material exists on the combined sites. Such material will need to be acquired and imported to the landfill location at a minimum cost of $7 million (current dollars).

APPENDIX

1. Emcon Geologic Sections showing alternate interpretation of soil profile

2. Patrick Excavation limits showing showing location of 10 soil borings

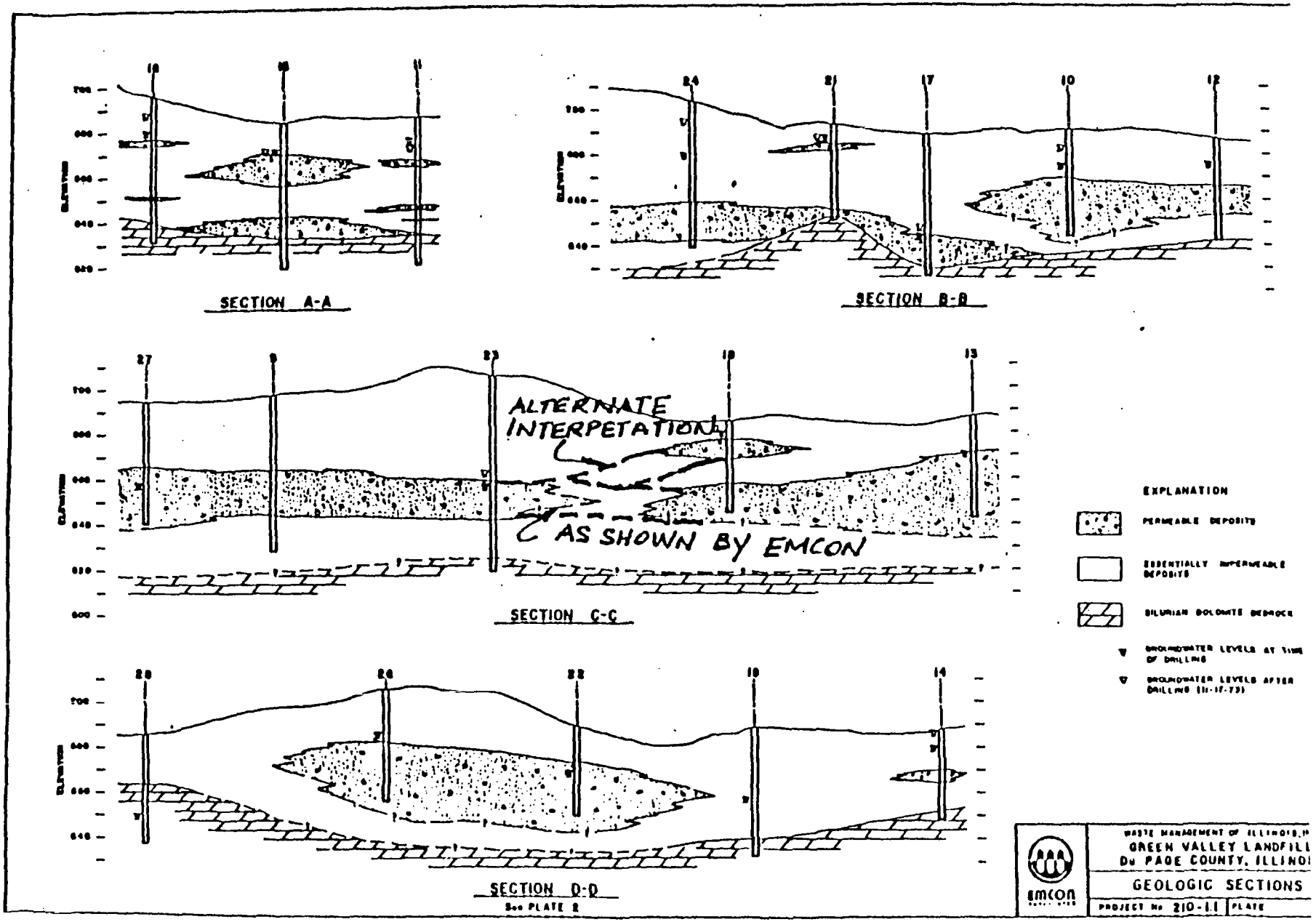
3. Testing Service Corp. log of boring 22 showing sand and gravel from 16.0' to 40.0'.

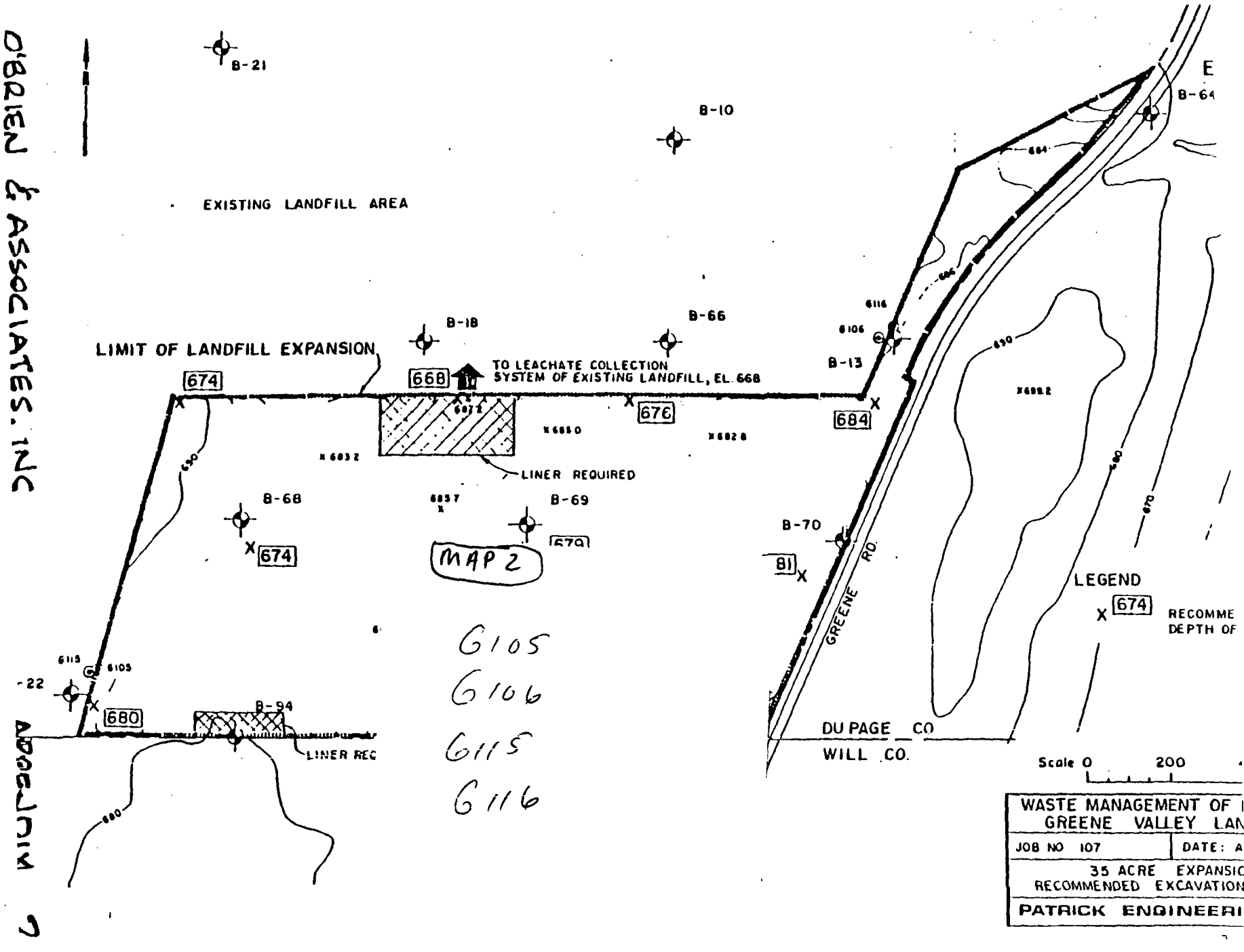
Prepared for Spaceco, Inc.

Prepared by O'Brien & Associates, Inc.
P.O. Box 1231
Arlington Heights, IL. 60006

O'BRIEN & ASSOCIATES, INC

APPENDIX I





O'BRIEN & ASSOCIATES, INC

ADDENDUM 1

PROJECT WASTE MANAGEMENT LANDFILL SITE, GREEN VALLEY FOREST PRESERVE, DuPAGE COUNTY

CLIENT GEOTECH INC., 224 North Broadway, Joliet, Illinois

BORING 22 DATE STARTED 10-10-73 DATE COMPLETED 10-10-73 JOB L-11,165

ELEVATIONS

GROUND SURFACE _____

END OF BORING _____

WATER TABLE

AT END OF BORING -35.0' Caved

24 HOURS -23.0'

Water encountered at -37.0' while drilling

Distance Below Surface in Feet	Length Recovery	Sample No.	Type	N	WC	Q_u	DRY	Depth	Elev.	Soil Descriptions
0								0.8		Black silty, clayey TOPSOIL
5		1	SS	42	14.6	4.5+*				Hard brown silty CLAY, with gravel, moist
10		2	SS	27	17.1	4.97 4.5+*				
15		3	SS	29				16.0		
20		4	SS	50/2"				20.0		Dense to very dense brown silty SAND, with broken gravel, occasional large boulders, moist
25		5	SS	50/1"						Very dense brown fine to medium silty SAND & broken limestone, with gravel, moist to wet
30		6	SS	50/2"						
35		7	SS	50/2"						
40		8	SS	50/1"						

End of Boring at 40.0 feet

* - Approximate unconfined compression strength based on measurements with a calibrated pocket penetrometer

DRILL RIG NO. 53

TESTING SERVICE CORPORATION